Space Weather Technical Forecast

Issued on Tuesday, 24 May 2022 at 01:21 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of R1-R2 Radio Blackouts through the forecast period.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low over the last 24 hours, with only C-class flares, mainly from AR3014 (Ekc/βγδ) and AR3017 (Eai/β) in the northwestern quadrant, which are the largest and most complex regions. AR3017 has shown some growth in its leader spots. The remaining six regions on the visible disc are all small and benign with limited development. Coronagraph imagery revealed a large prominence eruption on the northwest limb, although this appears to not be Earth-directed. Meanwhile, a C5.2 originating from AR3017 has produced a CME, which has yet to be analysed for any Earth-directed component. Currently, no Earth-directed CMEs have been observed in available imagery.

Solar Wind / Geomagnetic Activity: The solar wind, as observed at L1 has been elevated, peaking at around 550km/s, due to the high speed stream from coronal hole 82. Solar winds have been slowly declining, as the high speed stream from CH82 begins to wane, and are currently slightly elevated at around 470km/s. Density has been around or below average. Interplanetary magnetic field strength was weak between 3nT and 5nT, with the north-south component Bz varying between +4 and -4nT. Phi angle was mainly positive (away from the Sun) throughout. Total geomagnetic activity was Quiet.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) has been at background levels through the last 24 hours. The high energy electron flux (greater than 2 MeV) rose to moderate to high levels, peaking at 1051pfu at 23/1325UTC. The corresponding electron fluence remained well below the Active threshold (1e8 integrated pfu) with a rising then level trend to reach 4.6e7 integrated pfu at 24/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Low, although there is a chance of M-class flares, with the main risk from the two large regions in the northwest. Further active regions (seen in STEREO EUVI imagery) are likely to rotate onto the eastern hemisphere through the next four days.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs are currently expected. However, the aforementioned C-class flare, originating from AR3017 did produced a CME, which is yet to be analysed for any potential Earth-directed component. Solar winds are expected to decline through the next two days due to a declining high speed stream. Further elevated winds are then likely late on day 3 and into day 4 (26 and 27 May), due to a further forecast high speed stream, estimated to reach 500km/s. Geomagnetic activity is expected to be mainly Quiet with isolated Unsettled spells through days 1 and 2 (24 and 25 May) There is then a very slight chance of G1/Minor Storms by day 4 (27 May), due to a potential connection with the high speed stream from coronal hole 85.

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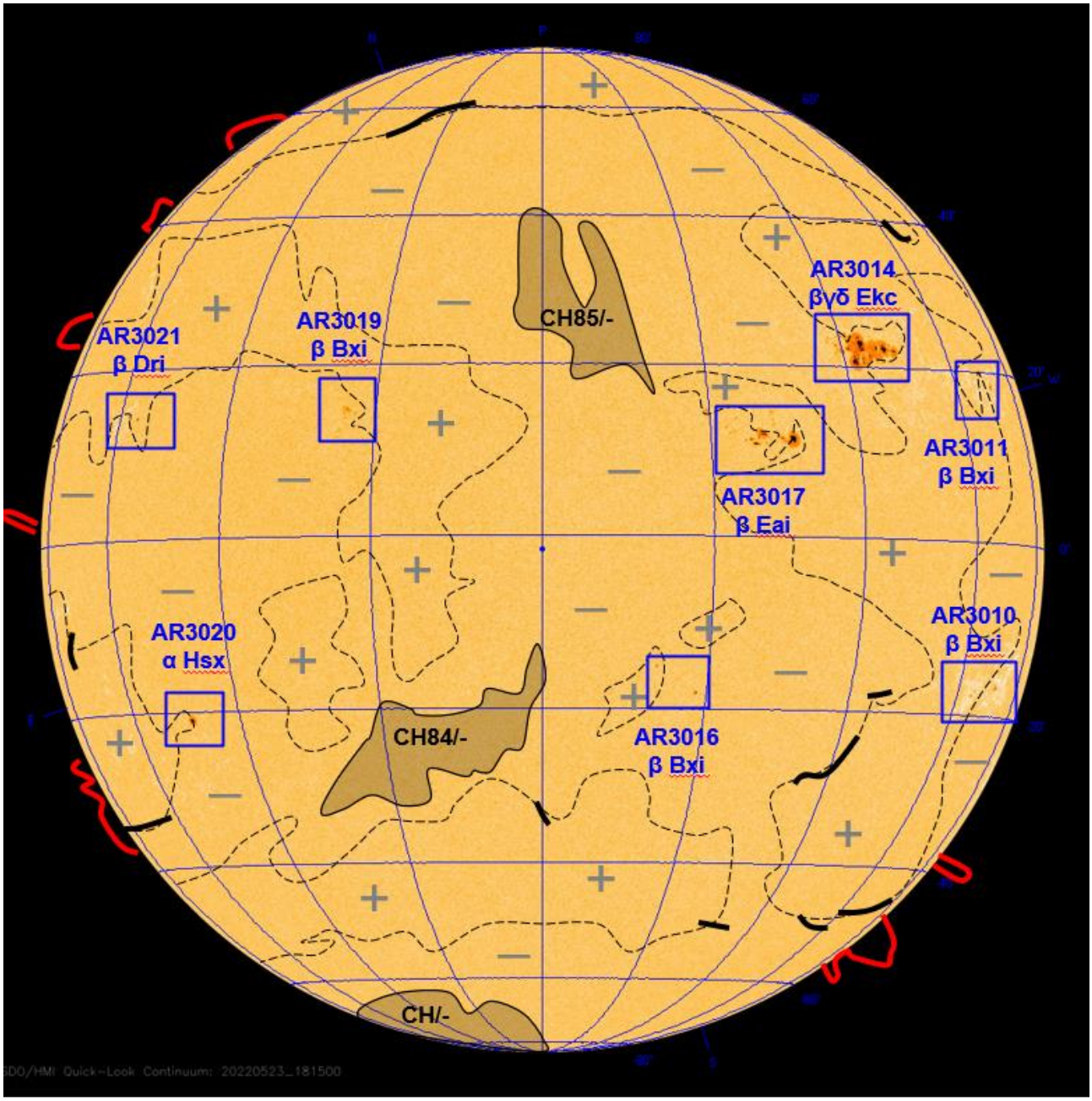
Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is expected to be at background levels during this period, with a slight chance of reach S1 levels. The high energy electron flux (greater than 2MeV) is expected to vary between mainly moderate and high levels on the diurnal cycle through the first couple of days. A sharp reduction is possible on days 3 and 4 (26 and 27 May) due to an increased geomagnetic activity. Electron fluence is expected to remain below the Active (1e8 integrated pfu) threshold.

Figure 1. Solar Analysis Valid 23/1815UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:
There are currently no CMEs forecast to arrive at Earth in the next 4 days. However, a CME was produced following a C-class flare originating from AR3017, which can be seen in STEREO-A, but currently awaiting further imagery for a better analysis of this feature, which could potentially have a Earth-directed component - pending analysis.

The high speed stream from coronal hole 82 is expected to gradually reach background levels on day 1 (24 May). Coronal hole 85 is then expected to connect on day 3 (26 May), with an estimated speed of 500km/s, although there is low confidence in this estimate as the coronal hole was not observed on STEREO A.

Geomagnetic activity is expected to be mainly Quiet with isolated Unsettled spells through days 1 to 2. There is then a very slight chance of G1/Minor Storms on days 3 and 4 (26 and 27 May), due to a potential connection with the high speed stream from coronal hole 85.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	10	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

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Radio Blackouts - X-Ray Flares:
AR3014 (Ekc/βγδ) is the largest and most significant sunspot region on the visible disc. This region has not evolved much in the last 24 hours and has not produced much flare activity, with no M-class flares observed since 20 May. A few small simple sunspots have developed around the edge of the main sunspot, but none of these are considered to be a major risk. AR3017 (Eai/β) is also relatively complex, with a peak flare of C5.2 at 23/1105UTC, which produced a CME, which has yet to be analysed for any potential Earth-directed CME, once coronagraph imagery is available. The remaining regions are considered relatively benign and contribute little to the overall flare risk.

The stated flare risk is around half of that from what would be expected from the two large and complex regions on the disc, with significant reductions in risk due to the recent history.
There are a number of potential active regions due to rotate onto the solar disc during the next four days, indicated by bright flux areas on STEREO A EUVI imagery although no CMEs or significant flares have been observed from these regions.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	40	40	40	40
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 2: SDO AIA 94 imagery – shows the C5.2 flare originating from AR3017.

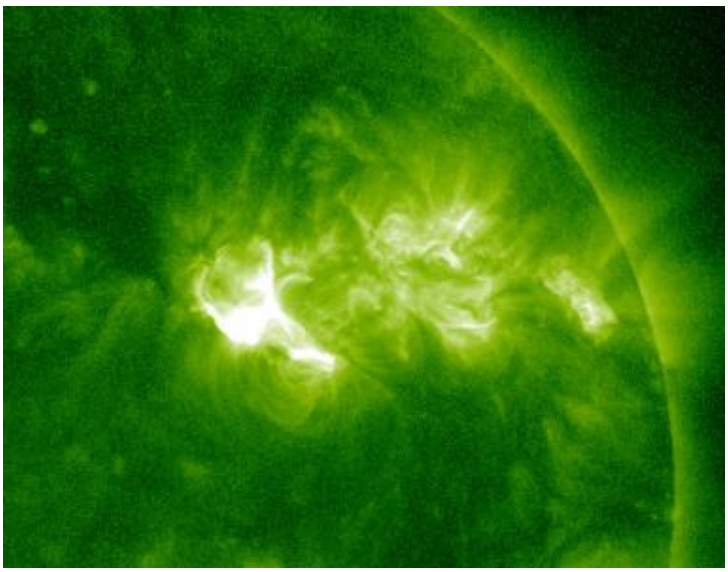

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Figure 3: GOES-16 X-ray flare observations – shows the C5.2 flare (yellow rectangle).

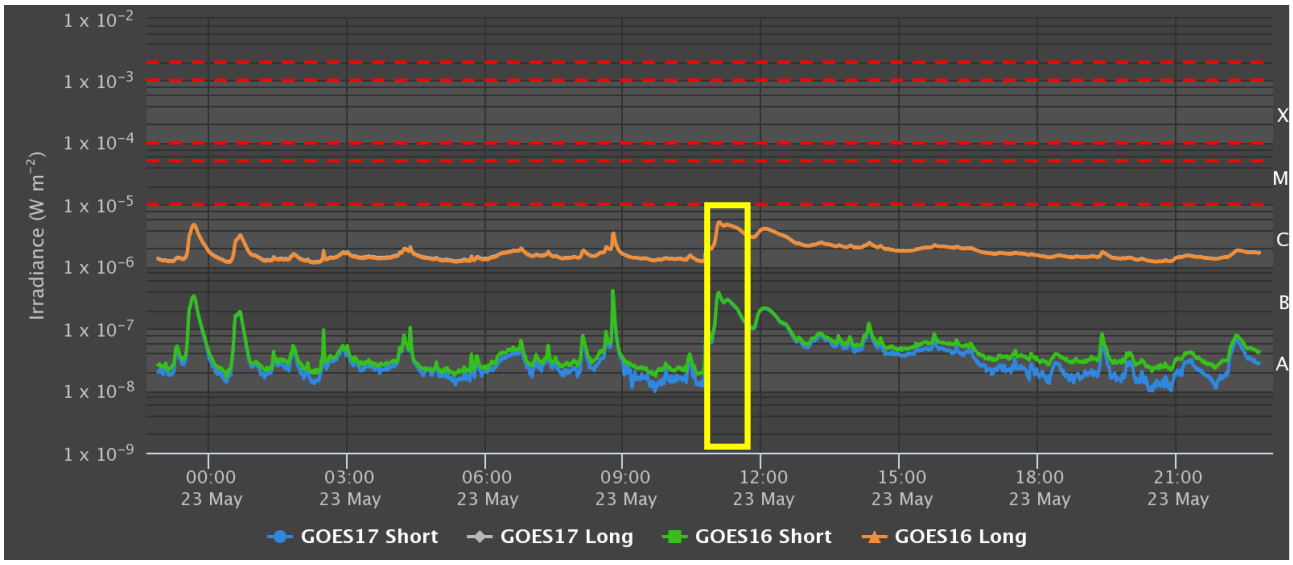
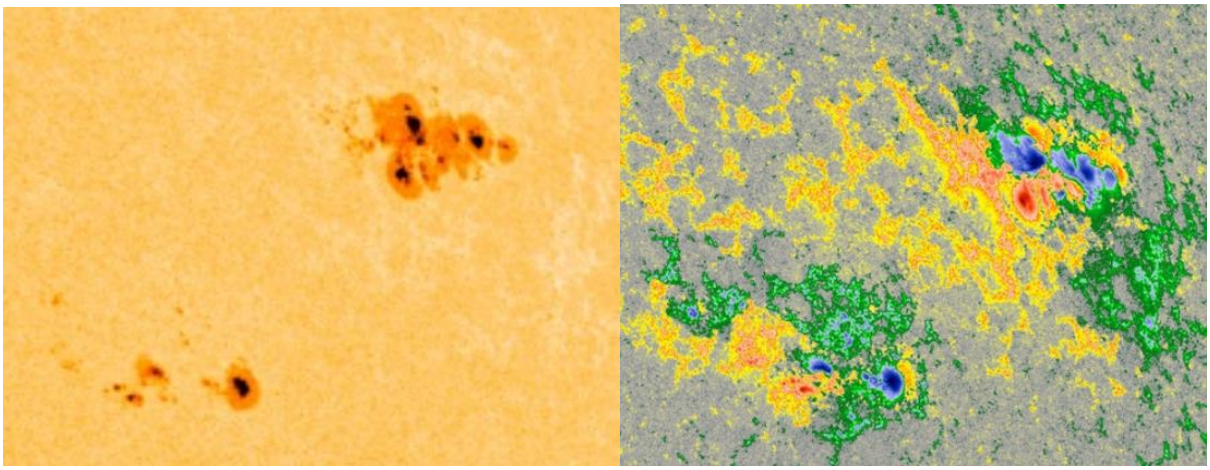


Figure 4: SDO HMI and SDO imagery of AR3017 (left) and AR3014 (right).



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Solar Radiation Storms - (High Energy Protons):
The high energy proton flux (greater than 10 MeV) is at background levels and is most likely to remain so through the period.

There is a slight increase in the risk of solar radiation storms through the next four days as regions AR3014 and AR3017 rotate towards the western limb, with this being the prime region for Earth-directed storms.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	10	10
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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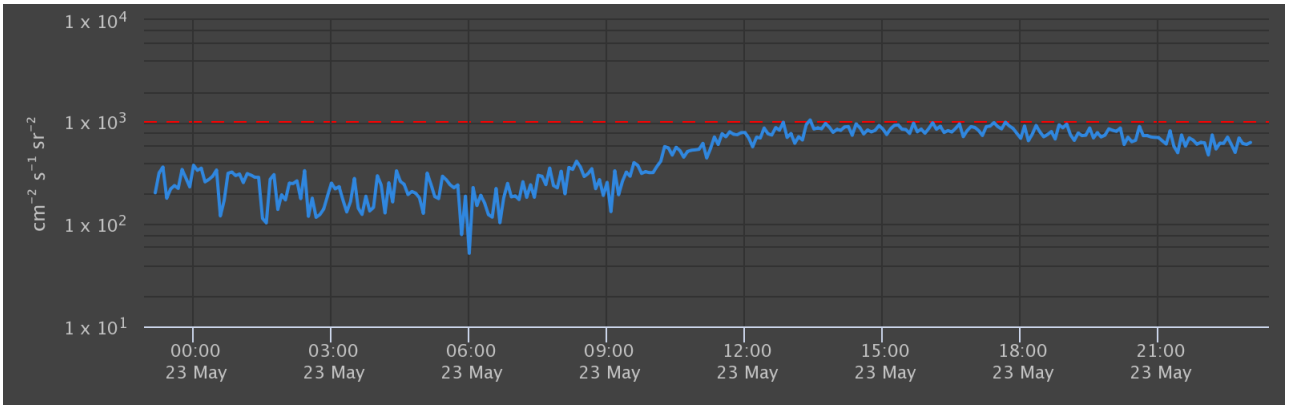
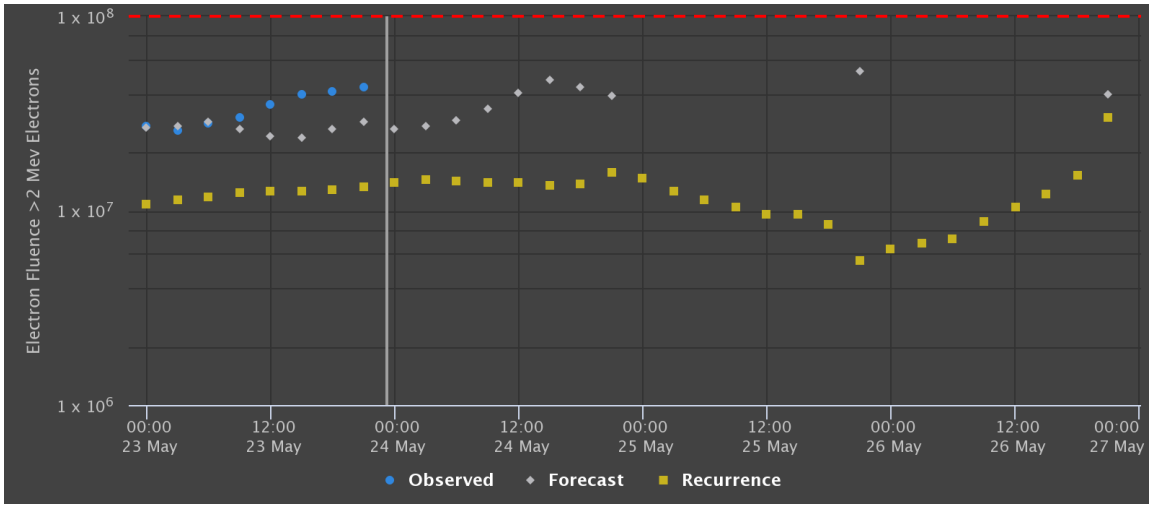
High Energy Electrons Event (≥ 2MeV):
The high energy electron flux (greater than 2MeV) is expected to vary between moderate and high levels in the diurnal cycle through days 1 and 2, under the influence of the high speed stream from coronal hole 82. This is expected to wane through this period, with a steady reduction in the peak values. Potential geomagnetic storms due to the next forecast high speed stream may inhibit electron increases on days 3 and 4 (26 and 27 May).

Electron fluence is likely to follow a declining peak during the next four days due to the forecast decline in electron flux peaks.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	10	10	5	1
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: GOES 16 electron flux and MOSWOC REFM model





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NOTE: Our REFM model has been upgraded and has changed in appearance. The two main changes are the option to include a recurrence graph, which superimposes observations from the last solar rotation onto the current solar rotation (each plot is the observation from T-minus 28 days). Recurrence is used as a guide to what can be expected in the coming days assuming no difference in solar features, and has low accuracy in certain situations but good accuracy in others (such as recurring coronal holes). The other change is the cadence of REFM forecast fluence data has been reduced past day 1 to only one value per day. The cadence remains 3-hourly for the first 24 hours.

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